POTENTIAL FOR PRODUCTION OF *ALOCASIA*, GIANT TARO, ON THE HAMAKUA COAST OF THE ISLAND OF HAWAII

Sione Foliaki
Research Division-Vaini Experimental Farm
Ministry of Agriculture, Forestry, and Fisheries
Nuku'alofa, Kingdom of Tonga

William S. Sakai
College of Agriculture
University of Hawaii at Hilo

Sauni T. Tongatule
Agriculture Department
Alofi, Niue

Unlucky Tungata
Ministry of Agriculture
Rarotonga, Cook Islands

Ron Ka'ipo, Sheldon C. Furutani, Marcel M. C. Tsang, Gregory Nielson, and Richard Short
College of Agriculture
University of Hawaii at Hilo

Abstract

Production of six cultivars of Alocasia macrorrhiza (L.) G. Don. in the Piihonua area near Hilo on the Island of Hawaii ranged from a high of over 70,000 pounds per production acre for the cultivar Tonga to a low of 14,000 pounds for the cultivar Niu Kini. `Tonga' and `Niu Kini' are the most popular cultivars in the South Pacific. Production for other cultivars were: `Fiasega'- 19,000 pounds, `Laufola'- 22,000, `Faitama' - 18,000, and `Accession 18'- 64,000. `Niu Kini' has purple coloring and `Fiasega' has yellow coloring, the other cultivars have white fleshed stems. Production of Alocasia on the Hamakua Coast and marketing for human consumption has potential if the markets can be found on Oahu and the West Coast. Because production of stems alone in terms of starch for `Tonga' is near 13,000 pounds per acre per year, there is a definite potential for production of Alocasia for use as feed for cattle, swine, and poultry. If a method can be developed to process the leaves and stems into palatable food it would decrease the dependency of these industries on imported grains.

Introduction

The giant taro, Alocasia macrorrhiza (L.) G. Don., is a member of the family Araceae and is closely related to taro (Colocasia). However, unlike taro, most of the edible part of the stem is produced above ground which allows for easier harvesting. The edible stem grows up from the planting material so is never deeper in the ground than about 6 to 8 inches. Alocasia is commonly grown in upland areas, high islands, or drier areas of atolls. Like the dryland taro it does not require flooding. Alocasia grows year around and can be harvested at any time when it is needed. However, larger plants do flower in the summer and this tends to slow growth.

Alocasia is thought to have originated in Sri Lanka or India (Plucknett, 1976). It is presently cultivated in Asia in the countries of India, Sri Lanka, and Bangladesh where crop time is from 6 to 11 months. The variety grown in Sri Lanka (Desai ala) appears to be a small variety with stems averaging 4 to 6 pounds when spaced 2 X 4 feet (Soyza, 1938). In Bangladesh and many parts of India, Alocasia is grown for the leaves as well as the stems (Rashid and Daunicht, 1979; Kundu, 1967). The stems are cut into cubes and used in curry and the young leaves are used in soups or fritters (Rashid, 1980).

In the Pacific region, Alocasia is grown in mixed plantings with taro, yams, and banana principally in Wallis, Futuna, Tonga, and Niue. In these areas the flavor is considered superior to taro. Crop time is 18 to 24 months and corms are reported to be 3 to 4 feet long, 6 to 8 inches in diameter and weigh about 40 pounds (Coursey, 1968; Plucknett, 1970; Watson, 1979). The stems are boiled in water or with added coconut milk, lightly salted and served. An alternate method is to bake the tubers whole alone or with ti tubers. The fructose sugar from the ti tubers during baking runs down over the Alocasia making them very sweet.

In Hawaii, Alocasia was planted in upland valleys and one cultivar apparently grows rapidly and produces large edible stems. However, the Hawaiian preference is for taro and because of this Alocasia has not been grown commercially in Hawaii to any great extent.

Materials and Methods

Interest in growing Alocasia on the Hamakua Coast first developed while gathering research publications for a review of the literature (Sakai, 1983) on the aroid root crops: Alocasia, Cyrtosperma (giant swamp taro), and Amorphophallus (konjac, konnyaku, or elephant foot yam). Arrangements were made for Jill Wilson, of The University of the South Pacific, Alafua Campus, to ship us plantlets of 6 cultivars of Alocasia. These arrived in Hilo with help from Ramon dela Peña of the Kauai Experiment Station and the staff at the Lyon Arboretum. The plantlets included the two major cultivars `Tonga' and `Niu Kini' and four others: `Fiasega', `Laufola', `Faitama' and `Accession 18'. The project was initiated when Mr. Sione Foliaki arrived at UH-Hilo to study for his B.S. in Agriculture. Mr. Foliaki had assisted Jill Wilson at Alafua and was familiar with the culture of Alocasia.

The experimental design was a randomized complete block with 6 cultivars, 4 replications, and 4 plants per replication. The spacing was 4 X 6 feet with a border row completely surrounding the planting.

The Alocasia were planted at the UHH-Agricultural Farm Laboratory on Waianuenue Avenue in soil of the Hilo Series. Huli were collected from plants maintained in pots at the Panaewa Farm. Initial planting was in February, 1988. However, the quality of the planting material was not good and roots were not established until March. Because of the weakened condition of the plants they were also infested with spider mites. These were controlled by spraying with wettable sulfur in late April. Because there was no appreciable growth of the plants until after the mites were controlled in May, the crop time should be estimated at one year with harvesting in May of 1989.

Fertilization was 250 lbs/acre/crop each of nitrogen, phosphate and potash. N as a preplant and at 3, 5, and 7 months; phosphate as a banded preplant; and potash as a preplant and at 5 months. Dolomite limestone was added as an amendment at 1000 lbs/acre.

Results and Discussion

In terms of growth and production the cultivars separated into two groups. In the first group were two cultivars: `Tonga' with an average stem weight of 38.9 pounds and `Accession 18' with an average weight of 35.6 pounds (Table 1). In the second group were `Laufola' (12.3 lbs.), `Fiasega' (10.5 lbs.), `Faitama' (10.0 lbs.), and `Niu Kini' (7.8 lbs.).

The cultivar with the greatest production was `Tonga'. At the spacing of 4 feet X 6 feet (24 square feet per plant) the production was 1.62 pounds per square foot. Multiplied by 43,560, this equals over 70,000 pounds per planted acre. `Tonga' develops into a huge plant (Fig. 1A, B). At harvest the larger plants were over 10 feet tall and had lateral spreads of over 15 feet. The largest stem was 41 inches long, 8 inches in diameter and weighed over 70 pounds. `Tonga' is thought to have originated in the Tonga, Wallis, and Futuna area and is among the most widely grown cultivars. The leaves are green, the stem flesh is white, and the plant is almost free of irritation (Barrau, 1961; Migvar, 1968).

The cultivar `Accession 18' had production almost equal to `Tonga' (Table 1). Production was 1.48 lbs. per square foot or over 64,000 lbs per planted acre. The largest stem was about 40 inches long, 9 inches in diameter and weighed over 70 pounds. `Accession 18' is thought to be a hybrid between `Laufola' and `Tonga'. It has the tremendous growth rate of `Tonga' with the upright growth form and leaf shape of `Laufola'. At harvest the largest plants were over 15 feet tall with a lateral spread of about 10 feet (Fig. 1C, D). The lower surface of the petioles of `Accession 18' are also slightly purple like `Laufola'. The stem flesh is white.

`Laufola', `Fiasega', `Faitama', and `Niu Kini' all had production levels that were less than a third of those of `Tonga' and `Accession 18'.

Production of `Laufola' was 0.51 pounds per square foot, which is about 22,000 pounds per planted acre (Table 1). The largest stem was 24 inches long, 7 inches in diameter, and weighed 32 pounds. At harvest the larger plants were about 8 feet tall and 6 to 8 feet in diameter (Fig 2A, B).

The cultivar `Fiasega' is variegated green and yellow. It is very striking and could probably be sold for landscape purposes. These variegated types of Alocasia are reported to be more irritating, but are grown for their flavor and the color of the stem flesh (Betham 1982). Production of `Fiasega' was 0.44 pounds per square foot, which is about 19,000 pounds per planted acre (Table 1). The largest stem was 18 inches long, 7 inches in diameter and weighed 20 pounds. The larger plants were about 6 feet tall and about 6 feet in diameter (Fig. 2C, D).

`Faitama' differs from the other cultivars in that it produces many offshoots from the base of the plant (Fig. 3A, B). It also appears to be better adapted to wetter conditions than the other varieties (Table II). On the wetter side of the plot this cultivar produced about 20,000 pounds per acre and on the drier side 14,000 pounds. This is exactly opposite of the other cultivars (Table II). Average production for `Faitama' was 0.42 pounds per square foot or 18,000 pounds per planted acre. The largest stem was 18 inches long, 6 inches in diameter and weighed 20 pounds. The larger plants were about 5 feet tall and about 4 feet in diameter (Fig. 3A, B).

`Niu Kini' is the dark purple cultivar that along with `Tonga' form the principle cultivars of the South Pacific. The midrib and the petiole is dark purple and the coloration continues into the veins of the stem. The stem flesh of `Niu Kini' resembles that of the taro cultivar `Bunlong'. Growth of this cultivar in the present trial was variable and not what was expected of a major cultivar. Average production for `Niu Kini' was 0.33 pounds per square foot or 14,000 pounds per planted acre. The largest stem was 20 inches long, 7 inches in diameter and weighed 23 pounds. The larger plants were about 5 feet tall and about 6 feet in diameter (Fig. 3C, D). `Niu Kini' differed from the other cultivars in that the orientation of the leaves was more horizontal, unlike the vertical orientation of the other cultivars.

Conclusions

I. Marketing for human consumption

Marketing of Alocasia would be primarily to the peoples of the South Pacific now living on this Island, on Oahu, and on the West Coast. Alocasia stems are presently being shipped from Tonga and arrive in New Zealand in excellent condition. Thus, storage and transport would probably not be a problem in marketing. Alocasia stems from Tonga are also being sold in California and apparently arrive there in good condition. Alocasia is also being grown and sold on Oahu at Laie.

In terms of production and flavor preferences, the grower would need to investigate the ethnic background of the consumers in each of the market areas. The cultivar `Tonga' is preferred by Tongans and the production levels in our trial would seem to be high. `Tonga' could also be sold to most of the peoples of the South Pacific. `Accession 18' has good production, but is not a recognized cultivar and may be difficult to market. `Niu Kini' is preferred by many of the peoples of the South Pacific, but the low production would require a higher selling price. We would suggest a planting space of 4 feet X 4 feet to increase production per square foot without affecting growth. We plan to replant `Niu Kini' in a drier area to determine if the production can be improved.

`Fiasega' could probably be sold at a premium price because of the yellow stems, if a market could be found. Production of `Laufola' would probably not be profitable because it has a white stem and production is much lower than `Tonga'. `Faitama' appears to be a cultivar that is ideal for the home garden where stems are small and can be harvested on a continual basis without replanting.

II. Marketing as a carbohydrate source for swine, cattle, and poultry production on the Hamakua Coast

There appears to be a tremendous potential for large scale production of Alocasia on the Hamakua Coast for use in swine, cattle, and poultry feed. Production of stems alone for the `Tonga' cultivar is over 70,000 pounds per production acre per year. Development of a silage using the leaf blades and petioles as well as the stem would increase this poundage and also increase the protein content. Stems of Alocasia from other areas of the world average from 16% to 21% starch (Sakai, 1983). Using these percentages, this calculates at about 11,000 to 15,000 pounds of starch per acre per year. The average yield of wheat world wide is 1.6 metric tons per hectare or 8,700 pounds per acre (Martin, Leonard, and Stamp, 1976). The stems of Alocasia are low in protein, but leaves are reported to contain 4.3% protein. Thus, it appears that development of methods for processing the stems and leaves of Alocasia into palatable food for the cattle, swine, and poultry industries on this Island may help to relieve the dependency on imported grains. Indeed, there is a definite need for further research on Alocasia.

Literature cited

Barrau, J. 1961. Subsistence agriculture in Polynesia and Micronesia. B. P. Bishop Museum Bulletin 223: 43-67.

Betham, R. (1982). Personal communication. Western Samoa, Samoan-German Crop Protection Center-Nuu.

Coursey, D. G. 1968. The edible aroids. World Crops 20(4):25-30.

Kundu, B. C. 1967. Some edible rhizomatous and tuberous crops of India. Proceedings of the International Symposium on Tropical Root Crops 1: 124-130.

Martin, J. H., W. H. Leonard, and D. L. Stamp. 1976. Principles of Field Crop Production, Third Edition. Macmillan Publishing Co., New York. p. 430.

Migvar, L. 1968. How to grow taros, yams, cassava, and sweet potatoes. Mariana Islands, Division of Agriculture, Department of Research and Development, Trust Territories of the Pacific Islands, Agriculture Extension Bulletin, Number 7, pp. 7-8.

Plucknett, D. L. 1970. Colocasia, Xanthosoma, Alocasia, Cyrtosperma, and Amorphophallus. Proceedings of the Second International Symposium on tropical Root and Tuber Crops 2: 127-135.

Plucknett, D. L. 1976. Edible aroids. In Evolution of Crop Plants (N. W. Simmonds, ed.). Longman, London and New York, pp. 10-12.

Rashid, M. M. 1980. Personal communication. Bangladesh Agricultural Research Institute, Dacca, Bangladesh.

Rashid, M. M., and H. J. Daunicht. 1979. Chemical composition of nine edible aroid cultivars of Bangladesh. Scientia Horticulturae 10: 127-134.

Sakai, W. S. 1983. Aroid Root Crops: Alocasia, Cyrtosperma, and Amorphophallus, In Handbook of Tropical Foods (H. T. Chan, Jr., ed.). Marcel Dekker, New York. pp. 29-83.

Soyza, D. J. de. 1938. Yam cultivation in the Kegalla district. Tropical Agriculture Magazine of the Ceylon Agricultural Society 90(2): 73-75.

Watson, J. 1979. Importing root crops from the South Pacific Islands for New Zealand markets. In Small-Scale Processing and Storage of Tropical Root Crops (D. L. Plucknett, ed.). Westview Press, Boulder, Colorado.

Table 1. Alocasia Production Cultivar Trial

Block No.	Plant No.	CULTIVAR Tonga	Niu Kini	Fiasega	Laugola	Fiatama	Acc 18
I	1	33.5	0.5	4.5	5.0	6.5	53.0
I	2	37.0	23.0	13.0	12.0	9.5	22.5
I	3	44.5	6.5	4.5	14.0	14.0	25.5
I	4	11.0	2.0	15.0	7.0	7.5	58.0
I Avg Wt		31.5	8.0	9.3	9.5	9.4	39.8
I lbs/sq ft		1.31	0.33	0.39	0.40	0.39	1.66
I lbs/acre		57,199	14,527	16,796	17,250	17,023	72,179

Block No.	Plant No.	CULTIVAR Tonga	Niu Kini	Fiasega	Laugola	Fiatama	Acc 18
II	1	8.0	5.0	12.0	2.5	21.0	4.0
II	2	58.0	7.0	11.5	15.0	7.0	5.5
II	3	53.5	2.0	4.5	3.0	16.5	76.0
II	4	51.0	8.0	14.0	20.0	7.0	41.0
II Avg Wt		42.5	5.5	10.5	10.1	12.9	31.6
II lbs/sq ft		1.77	0.23	0.44	0.42	0.54	1.32
II lbs/acre		77,173	9,987	19,066	18,385	23,379	57,426

Block No.	Plant No.	CULTIVAR Tonga	Niu Kini	Fiasega	Laugola	Fiatama	Acc 18
III	1	42.0	11.0	12.0	7.50	7.5	78.0
III	2	40.5	7.0	8.5	9.0	2.5	28.0
III	3	37.0	3.5	6.0	20.5	11.0	58.0
III	4	30.0	0.5	11.5	32.0	6.5	1.5
III Avg Wt		37.4	5.5	9.5	17.3	6.8	41.4
III lbs/sq ft		1.56	0.23	0.40	0.72	0.28	1.72
III lbs/acre		67,867	9,987	17,250	31,323	12,257	75,130

Block No.	Plant No.	CULTIVAR Tonga	Niu Kini	Fiasega	Laugola	Fiatama	Acc 18
IV	1	70.0	24.5	6.0	11.5	7.5	2.0
IV	2	5.0	10.0	20.0	16.5	12.0	52.0
IV	3	50.0	11.0	14.0	9.0	6.5	34.0
IV	4	52.0	3.5	14.0	9.0	6.5	34.0
IV Avg Wt		44.3	12.3	12.9	12.3	9.3	29.5
IV lbs/sq ft		1.84	0.51	0.54	0.51	0.39	1.23
IV lbs/acre		80,351	22,244	23,379	22,244	16,796	53,567

Total	CULTIVAR Tonga	Niu Kini	Fiasega	Laugola	Fiatama	Acc 18
Avg Wt	38.9	7.8	10.5	12.3	10.0	35.6
lbs/sq ft	1.62	0.33	0.44	0.51	0.42	1.48
lbs/acre	70,647	14,185	19,112	22,300	18,158	64,576

Table 2. Comparison of Production from Wetter* and Drier Side of Experimental Plot

WETTER SIDE			CULTIVAR			
Lbs/acre	Tonga	Niu Kini	Fiasega	Laugola	Fiatama	Acc 18
BLOCK I	57,119	14,527	16,796	17,250	17,023	72,130
BLOCK II	77,173	9,987	19,066	18,385	23,379	57,426
AVERAGE	67,146	12,257	17,931	17,818	20,201	64,803

DRIER SIDE			CULTIVAR			
Lbs/acre	Tonga	Niu Kini	Fiasega	Laugola	Fiatama	Acc 18
BLOCK III	67,867	9,987	17,250	31,323	12,257	75,130
BLOCK IV	80,351	22,244	23,379	22,244	16,796	53,567
AVERAGE	74,109	16,116	20,315	26,784	14,527	64,349

*Wetter side received run-off of rain from roof of greenhouse adjacent to the plot. Drainage ditches surrounded the plot, but the drier side was also adjacent to a slope. Rainfall for the year ending May, 1989 was 155 inches.

Figures 1A & 1B. Plants of the cultivar 'Tonga' after one year of growth. Note the spreading habit of the leaves. Flowers are visible near the top of the plant in 1A. Note the shape of the stem after the leaves have been removed in 1B. The stem of this plant extended 8 inches into the ground. Figures 1C & D. Plants of the cultivar 'Accession 18' after one year of growth. Note the more upright form of leaves. Ruler is 18 inches long. Photographs taken in May, 1989.

Figures 2A & B. Plants of the cultivar 'Laufola' after one year of growth. Note the upright form of the leaves that is similar to 'Accession 18'. Figures 2C & D. Plants of the cultivar 'Fiasega' after one year of growth. Note the light colored petioles and leaf veins which are yellow. Ruler is 18 inches long. Photographs taken in May, 1989.

Figures 3A & B. Plants of the cultivar 'Faitama' after one year of growth. Note the production of many keikis at the base of the stem. This cultivar could probably be continuously harvested without replanting. Figures 3C & D. Plants of the cultivar 'Niu Kini'. In 3C the plants have just been planted. The white stake is about 1 foot tall. In 3D the plants after one year of growth. Note the spreading habit of the leaves. The dark colored petioles are purple. Ruler is 18 inches long.

The Library of Congress has catalogued this serial publication as follows:

Research Extension series / Hawaii Institute of Tropical Agriculture and Human Resources.—001— [Honolulu, Hawaii]:
The Institute, [1980–
v. : ill. ; 22 cm
Irregular.
Title from cover.
Separately catalogued and classified in LC before and including No. 044.
ISSN 0271-9916 = Research Extension Series - Hawaii Institute of Tropical Agriculture and Human Resources.
1. Agriculture—Hawaii—Collected works. 2. Agriculture—Research—Hawaii—Collected works. I. Hawaii Institute of Tropical Agriculture and Human Resources. II. Title: Research Extension Series - Hawaii Institute of Tropical Agriculture and Human Resources.
S52.5R47 630'.5—dc19 85-645281
AACR 2 MARC-S
Library of Congress [8506]